Year	Subject Title	Sem	Sub Code
2018–19 Onwards	I B.Sc. (Computer Science) STATISTICS & NUMERICAL METHODS	I	18BCS16A

Objective: To improve the mathematical skills among the students

UNIT I

Measures of Central Tendency: Mean, Median and Mode - Relationship among Mean, Median and Mode - Uses, Merits and Demerits - Measures of Dispersion: Range - Quartile Deviation - Mean Deviation - Standard Deviation and Coefficient of Variation.

UNIT II

Skewness: Meaning - Bowley's and Karl Pearson's Measures of Skewness. Correlation (Two Variable Linear Case) - Meaning - Scatter Diagram - Types of Correlation - Karl Pearson Correlation Coefficient – Concurrent Deviation Method - Rank Correlation.

UNIT III

Linear Regression - Regression Equations for Two Variables - Regression Coefficients - Properties - Curve Fitting: Linear - Simple Problems.

UNIT IV

Numerical Methods - System of Simultaneous Equations: Gauss Elimination- Gauss Siedal Methods - Interpolation: Newton's Forward and Backward Interpolation Formula - Lagrange's Interpolation (No Derivations) - Simple Problems Only.

UNIT V

Numerical Differentiation: Newton Forward Difference - Newton Backward Difference . Numerical Integration: Trapezoidal Rule, Simpson Rule 1/3 rd and 3/8 th rules.

Text Books:

1. S.C.Gupta and V.K.Kapoor - Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 11th revised Edition, June 2012.
1. P.Kandasamy, K. Thilagavathy, K. Gunavathi - Numerical Methods, S. Chand & Company Ltd, New Delhi.

Reference Books:

1. V.Rajaraman - Computer Oriented Numerical Methods.
2. P. R. Vittal - Business Statistics, Margham Publications, Chennai.

Unit - I

Measure Of Central Tendancy And

Measures of Disperion..

Measure Of Central Tendancy

Definition :-

Prof. Bowley defind measure of central Tendancy or average as "Statistical Constants Which enables us to Comprerend. in a Single effort the significance of the whole.

* The five measures of central tendancy

1. Arithmetic mean
2. Median
3. Mode
4. Geomentric mean
5. Harmonic mean

Conditions for a good measure of central tendancy

* It should be rigidly defined.

* It Should be readily Comprehensiable easy to Caluclate.

* It Should be ~~bas~~ based on all the observations.

* It Should be Siutable for the Mathematical Caluclation

* It Should be affected on little as Possiable by fluctuations of Samplying

* It should not be affected much by extreme values.

Formulas :-

1. Airthmetic Mean (or) Mean

for $x_1, x_2 \ldots x_n$ can be defined as.

$$A.M = \bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n}$$

$$\boxed{\bar{x} = \frac{\Sigma x}{n}}$$

2. For an frequency distribution can be defined as.,

$$\bar{x} = \frac{x_1 f_1 + x_2 f_2 + \cdots + x_n f_n}{f_1 + f_2 + \cdots + f_n}$$

$$\bar{x} = \frac{\Sigma xf}{n}$$

Example 1 :-

Find Airthmetic mean of.

10, 40, 20, 15, 9, 17, 18, 13, 4

Solution :

$$\bar{x} = \frac{\Sigma x}{n} \qquad n = 9$$

$$= \frac{10 + 40 + 20 + 15 + 9 + 17 + 18 + 13 + 4}{9}$$

$$= \frac{146}{9}$$

$$\bar{x} = 16.222$$

Example 2 :

Find Airthmetic mean of frequency distribution.

x :	5	10	15	20	25	30	35	40
f :	2	4	25	40	30	19	6	4

Solution!

x	f	xf
5	2	10
10	7	70
15	25	375
20	40	800
25	30	750
30	19	570
35	6	210
40	4	160
	133	2945

$n = 183$

$$\bar{X} = \frac{\Sigma xf}{n}$$

$$= \frac{2945}{133}$$

$$\boxed{\bar{X} = 22.14}$$

Example 3:-

Find the Airthmetic mean of the following frequency distribution.

Class interval	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency	5	15	20	30	45	22	11

Solution:

class interval	mid(x)	frequency (f)	x f
0-10	5	5	25
10-20	15	15	225
20-30	25	20	500
30-40	35	30	1050
40-50	45	45	2025
50-60	55	22	1210
60-70	65	11	715
	$n = 148$		5750

$$\bar{x} = \frac{\Sigma xf}{n}$$

$$= \frac{5750}{148}$$

$$\boxed{\bar{x} = 38.85}$$

Merits of Airthmetic Mean :-

* It is rigidly defined
* It is easy to understand and easy to calculate.
* It is based upon all the observation.
* It is amenable to algebraic treatment
* Arithmetic mean is affected least by fluctuations of Sampling.

Demerits of Arithmetic Mean

* It cannot be determined by inpection nor it can be located graphically.

* Arithetic mean cannot be used if we are dealing with qualitative characteristics

* Mean cannot be calculated if single observation is missing

* It is affected very much by effective values.

* Airthmetic mean may lead to wrong conclusions, if the details of the date from which it is computer are not given.

Exercise:

1. find AM for the following:

60, 90, 30, 150, 117, 85, 90, 15, 110, 100

Solution:

$$\bar{x} = \frac{\Sigma x}{n} \qquad n = 10$$

$$= \frac{60+90+30+150+117+85+90+15+110+100}{10}$$

$$= \frac{807}{10} \Rightarrow \boxed{\bar{x} = 80.7}$$

2. The Weights of 15 students are given following . Find $\bar{x}$.

50, 45, 60, 75, 80, 49, 59, 60, 75, 80, 39, 45, 50, 70, 60.

Solution: $n = 15$,

$$\bar{x} = \frac{\Sigma x}{n}$$

$$= \frac{50 + 45 + 60 + 75 + 80 + 49 + 59 + 60 + 75 + 80 + 39 + 45 + 50 + 70 + 60}{15}$$

$$= \frac{897}{15}$$

$$\boxed{\bar{x} = 59.8}$$

3.

x :	5	10	15	20	25	30	35	40	45
f :	3	12	18	30	42	39	20	7	4

Solution:

x	f	xf
5	3	15
10	12	120
15	18	270
20	30	600
25	42	1050
30	39	1170
35	20	700
40	7	280
45	4	180
	145	4385

$$\bar{x} = \frac{\Sigma xf}{n}$$

$$= \frac{4385}{145}$$

$$\boxed{\bar{x} = 25.057}$$

4. Class interval } 0-5 5-10 10-15 15-20 20-25 25-30 30-35

Frequency - 4 15 30 42 79 60 40

Solution

class interval	mid x	f	xf
0-5	2.5	4	10
5-10	7.5	15	112.5
10-15	12.5	30	375
15-20	17.5	42	735
20-25	22.5	79	1777.5
25-30	27.5	60	1650
30-35	32.5	40	1300
35-40	37.5	11	412.5
		281	6372.5

$$\bar{x} = \frac{\Sigma xf}{N} \Rightarrow \frac{6372.5}{281}$$

$$\bar{x} = 22.677$$

5. Class interval } 0-10 10-20 20-30 30-40 40-50 50-60 60-70

15 40 75 110 80 22 10

Solution!

C.I	mid x	f	xf
0-10	5	15	75
10-20	15	40	600
20-30	25	75	1875
30-40	35	110	3850
40-50	45	80	3600
50-60	55	22	1210
60-70	65	10	650
		352	11,860

$$\bar{x} = \frac{\Sigma xf}{N} = \frac{11860}{352}$$

$$\bar{x} = 33.693$$

Median:

Median is the value of the variable that divides the given data into two equal parts.

Example 4:

Find median

9, 40, 16, 34, 18, 25, 17, 4, 10, 12, 15

Solution:

write in the ascending order

4, 9, 10, 12, 15, 16, 17, 18, 25, 34, 40

Median = 16.

If the no. of data is even for example in the above data add one more value 50. we get.

4, 9, 10, 12, 15, 16, 17, 18, 25, 34, 40, 50

$$\text{Median} = \frac{16+17}{2} \Rightarrow \frac{33}{2}$$

$$= 16.5$$

Example 5:

Find median for the following frequency distribution.

x :	4	8	12	16	20	24	28	32
f :	3	7	15	20	9	4	3	1

Solution:

x	f	cf
4	3	3
8	4	10
12	15	25
16	20	45
20	9	54
24	4	58
28	3	61
32	1	62

1. find $N/2 \Rightarrow 62/2 = 31$

2. Identify a c.f ~~62~~ 45 is greates than 31

3. Median = 16. (Corresponding x is the median).

Example 6:

Find Median for the following frequency distribution.

class interval	0-5	5-10	10-15	15-20	20-25	25-30	30-35
frequency	7	15	30	45	22	11	5

Solution:

Class interval	Frequency	c.f
0-5	7	7
5-10	15	22
10-15	30	52
15-20	45	97
20-25	22	119
25-30	11	130
30-35	5	135

1. $\frac{N}{2} = \frac{135}{2} \Rightarrow 67.5$

2. The commulative frequency gives greatest than 67.5 is 97.

* The class interval corresponding to the commulative frequency 97 is 15-20.

3. $\text{Median} = l + \frac{h}{f}\left(\frac{N}{2} - c\right)$

where,

l - lower limit of the median C.I

h - width of the C.I

f - frequency of the median C.I

N - total frequency

c - c.f of the C.I preceding the median C.I

$\therefore$ median $= 15 + \frac{5}{45}\left(\frac{135}{2} - 52\right)$

$= 15 + 0.11\,(67.5 - 52)$

$= 15 + 0.11 \times 15.5$

$= 15 + 1.705$

Median $= 16.705$

Merits of Median :

* It is rigidly defined.
* It is easily understand and it is easy to calculate.
* It is not at all affected by extreme values.
* It can be calculated for distributions with open end classes.
*

Demerits of Median :

* In case of even numbers of observation Median. Cannot be determined exactly
* It is not based on all the observation.
* It is not amenable to algebraic treatment.
* As compared with mean it is affected by fluctuation of sampling.

Exercise : 6

Find Median.

17, 20, 45, 19, 16, 30, 18, 44, 75, 64, 30

Solution:

given data:

16, 17, 18, 19, 20, 30, 30, 44, 45, 64, 75

Median = 30.

Exercise : 7

Find Median.

10, 40, 60, 30, 20, 120, 140, 58, 90, 60, 20, 100

Solution:

given data is write ascending order.

10, 20, 30, 40, 58, 60, 60, 90, 100, 120, 140

$$\text{Median} = \frac{58+60}{2} \Rightarrow \frac{118}{2} \Rightarrow 59.$$

Exercise : 8

Find Median

x :	3	6	9	12	15	18	21	24	27
f :	7	15	30	45	60	50	25	11	4

Solution:

x	f	cf
3	7	7
6	15	22
9	30	52
12	45	97
15	60	157
18	50	207
21	25	232
24	11	243
27	4	247

1. $\frac{N}{2} = \frac{247}{2} \Rightarrow 123.5$

2. The commulative frequency is 157 is greater than 123.5

3. Median = 15.

Exercise :9

Find median for the following frequency distribution:

(i).

C.I :	0-10	10-20	20-30	30-40	40-50	50-60	60-70
f :	9	24	40	60	35	17	5

Solution:

class Interval	frequency	Commulative frequency
0 - 10	9	9
10 - 20	24	33
20 - 30	40	73
30 - 40	60	133
40 - 50	35	168
50 - 60	17	185
60 - 70	5	190

1. $N/2 = 190/2 \Rightarrow 95$

2. The commulative frequency 133 is greater than 95.

3. Median $= l + \frac{h}{f}\left(\frac{N}{2} - C\right)$

$= 30 + \frac{10}{60}\left(\frac{190}{2} - 73\right)$

$= 30 + 0.166\,(95 - 73)$

$= 30 + (0.166)(22)$

$= 30 + 3.652$

Median $= 33.652$

(ii). C.I : 0-15 15-30 30-45 45-60 60-75 75-90 90-105

f : 15 25 49 70 54 30 16

Solution:

class Interval	frequency	Commulative frequency.
0-15	15	15
15-30	25	40
30-45	49	89
45-60	70	159
60-75	54	213
75-90	30	243
90-105	16	259

1. $N/2 = \frac{259}{2} \Rightarrow 129.5$

2. The Commulative frequency 159 is greater than 129.5

∴ The Commulative frequency 159 is. Corresponding to the interval of 45-60

3. Median $= L + \frac{h}{f}(N/2 - C)$

$= 45 + \frac{15}{70}\left(\frac{259}{2} - 89\right)$

$= 45 + 0.214(129.5 - 89)$

$= 45 + 8.667$

∴ Median = 53.667 //.

MODE.

Mode is the value of the variable Corresponding to the maximum frequency. That is it is the number which is repeated more number of time.

For row data to find mode. We have to identify the number that is repeated more number of time.

For example, mode for 6, 8, 8, 9, 12, 16, 15, 30, 40, 40, 50 is 40 since it is repeated 3 times.

Example : 7.

Find mode for the following frequency distribution.

x :	3	6	9	12	15	18	21	24
y :	2	7	15	30	60	42	29	4

Solution:

Here the mode value is 15. Since it is repeated 60 times.

Example 8:

Compute mode for the following frequency distribution.

C.I	0-10	10-20	20-30	30-40	40-50	50-60	60-70
f	7	15	30	45	25	11	7

Solution:

i). Identify the maximum frequency.

ii). The C.I, Corresponding to the maximum frequency is called mode class interval Because this is the class interval which contain the value of mode. To find the value of mode.

To find the value of mode,

By using formula;

$$\text{mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

Where,

$l \Rightarrow$ is the lower limit of the mode class interval.

$h \Rightarrow$ is the width of the class interval

$f_0 \Rightarrow$ is the frequency of the class interval Preceding the mode of class interval.

$f_1 \Rightarrow$ is the frequency of the mode C-I.

$f_2 \Rightarrow$ is the frequency of the class interval succeding the mode of class interval.

45 is the maximum frequency Hence the Corresponding Interval 30-40 is the moode C-I

Here :

$l = 30$, $h = 10$, $f_0 = 30$, $f_1 = 45$, $f_2 = 25$

Substituting the know Values we get,

$$\text{Mode} = 30 + \frac{10(45-25)}{2\times45-30-25}$$

$$= 30 + \frac{10\times20}{90-55}$$

$$= 30 + \frac{200}{35} \Rightarrow 30 + 5.71$$

Mode = 35.71.

Exercise:

10. Find mode

x	5	10	15	20	25	30	35	40	45
f	2	8	25	40	60	75	52	30	4.

Solution:

Here the mode value is 30. Since it is Repeated 75 times.

11. Find mode for the following distribution

C-I	0-5	5-10	10-15	15-20	20-25	25-30	35-40
f	6	12	30	45	25	11	4.

Solution!

45 is maximum frequency. Hence the corresponding of C-I, 15-20 is the mode class interval.

$l = 15,\ h = 5,\ f_0 = 30,\ f_1 = 45,\ f_2 = 25.$

Substituting the known values we get,

$$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

$$= 15 + \frac{5(45 - 30)}{2 \times 45 - 30 - 25}$$

$$= 15 + \frac{5(15)}{90-55}$$

$$= 15 + \frac{75}{35}$$

$$= 15 + 2.148$$

Mode = 14.1428

Example

Find mode:

Daily wages in Rs	50-60	60-70	70-80	80-90	90-100
No. of lab	40	62	75	100	65

Solution:

Here the maximum frequency is 100

$\therefore$ 80 - 90 is the mode of the class interval.

Here,

$l = 80$, $h = 10$, $f_0 = 75$, $f_1 = 100$, $f_2 = 65$

$$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

$$= 80 + \frac{10(100 - 75)}{2(100) - 75 - 65}$$

$$= 80 + \frac{10(25)}{200 - 140} \Rightarrow 80 + \frac{250}{60}$$

$= 80 + 4.166 \Rightarrow$ mode $= 84.166$ //.

Example: Calculate the mode.

Marks	0-19	20-39	40-59	60-79	80-99
No. of Students	5	20	35	20	12

First Convert the above into true intervals

Solution:

Marks	True Class interval	No. of Students.
0-19	-0.5-19.5	5
20-39	19.5-39.5	20
40-59	39.5-59.5	35
60-79	59.5-79.5	20
80-99	79.5-99.5	12

Here 35 is maximum frequency Hence 39.5-59.5 is the corresponding c.I

$$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

$l = 40, \quad h = 20, \quad f_1 = 35, \quad f_2 = 20, \quad f_0 = 20$ Then:

$$\text{Mode} = 40 + \frac{20(35-20)}{2\times 35 - 20 - 20} \Rightarrow 40 + \frac{20(15)}{70-40}$$

$$= 40 + \frac{300}{30} \Rightarrow 40 + 10 \Rightarrow \text{Mode} = 50$$

Example:

Find mean, median, Mode for the following.

C-I	0-10	10-20	20-30	30-40	40-50
f	3	5	9	3	2

Solution:

C-I	frequency	mid x	xf	c.f
0-10	3	5	15	3
10-20	5 f_0	15	75	8
20-30	9 f_1	25	225	17
30-40	3 f_2	35	105	20
40-50	2	45	90	22

$\Sigma xf = 510$

$N = 22$

i). Mean $= \frac{\Sigma xf}{N}$

$\bar{x} = \frac{510}{22} \Rightarrow$ Mean $= 23.18$ //.

ii). Median $= l + \frac{h}{f}\left(\frac{N}{2} - C\right)$

Here,

$\frac{N}{2} = \frac{22}{2} = 11$ The Corresponding frequency that is Greater than 11 is 17. The 20-30 is the median class interval

Here,

$l = 20,\ h = 10,\ f = 9,\ N = 22,\ c = 8.$

$$\therefore \text{Median} = l + \frac{h}{f}\left(\frac{N}{2} - c\right)$$

$$= 20 + \frac{10}{9}\left(\frac{22}{2} - 8\right)$$

$$= 20 + \frac{10}{9}(11 - 8)$$

$$= 20 - \frac{10}{9}(3) \Rightarrow 20 + \frac{10}{3}$$

$$= 20 + 3.33$$

$$\text{Median} = 23.33 //.$$

iii). Mode :

$$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

Here 9 is the maximum frequency correspon _ding class interval. 20-30 is the mode of class interval.

Here, $l = 20,\ h = 10,\ f_1 = 9,\ f_0 = 5,\ f_2 = 3$

Substitute the know values we get

$$\text{Mode} = 20 + \frac{10(9-5)}{2 \times 9 - 5 - 3}$$

$$= 20 + \frac{10(4)}{18-8} \Rightarrow 20 + \frac{40}{10} \Rightarrow 24 //.$$

Median = 23.33, Mode = 24,

Mean = 23.18.

Merits of Mode

1. Mode is readily comprehensiable and easy to calculate like median, mode Can be located in some case by inspection.

2. Mode is not at all affected by extreme Values.

3. Mode can be conveniéntally located even if the frequency distribution has C-I of Unequal magnitude. Provided the model class and classes Preceding and Succesding it are the of the Sance magnitude.

Demerits

1. Mode is ill defined. It is not alloays Possible to find a clearly definded mode.

2. It is not based on all the observation

3. It is not capable of further mathemat-
-cal treatment.

4. As compared with mean, mode is affect
-ed to a greater extent, by fluctuations
of samplify.

Relationship between Mean, Median, Mode.

Mode = 3 Median − 2 Mean.

Example:

(i) .. Mode if $\bar{x} = 20$, Median = 19

Solution:

Mode = 3 Meadian − 2 Mean

= 3 × 19 − (2 × 20)

= 57 − 40

Mode = 14.

(ii). Median if $\bar{x} = 10.5$ and Mode = 12.3

Solution:

Mode = 3 Median − 2 Mean

= ~~3 × 10.5 − 2 × 12.3~~

It can be rewritten as.

$$3\,\text{Median} = \text{Mode} + 2\,\text{Mean}$$

$$\text{Median} = \frac{\text{Mode} + 2\,\text{Mean}}{3}$$

$$= \frac{12.3 + (2 \times 10.5)}{3}$$

$$= \frac{12.3 + 21}{3}$$

$$= \frac{33.3}{3}$$

$$\text{Median} = 11.1 \text{ //}$$

(iii). Mean if Meadian = 118.23 and Mode = 119.19.

Solution:

$$\text{Mode} = 3\,\text{Median} - 2\,\text{Mean}$$

It can be rewritten as:

$$2\,\text{Mean} = \text{Mode} - 3\,\text{Median}$$

$$2\,\text{Mean} = \frac{3\,\text{Meadian} - \text{Mode}}{2}$$

$$= \frac{(3 \times 118.23) - 119.9}{2}$$

$$= \frac{354.69 - 119.9}{2} \Rightarrow \frac{235.5}{2}$$

$$\text{Mean} = 1187.75 \text{ //}$$

Exercises.

Compute Mean, Median and Mode for the following frequency distribution.

1.

C-I	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
f	5	14	28	24	18	7	3	1

Solution:

C-I	f	mid x	xf	c.f
0-10	5	5	25	5
10-20	14	15	210	19
20-30	28	25	700	47
30-40	24	35	840	71
40-50	18	45	810	89
50-60	7	55	385	96
60-70	3	65	195	99
70-80	1	75	75	100
	N = 100		Σxf = 3240	

(i). Mean $= \frac{\Sigma xf}{N} = \frac{3240}{100} = 32.4$

(ii). Median $= l + \frac{h}{f}\left(\frac{N}{2} - c\right) \Rightarrow \frac{N}{2} = \frac{100}{2} = 50$

Here $l = 30$, $h = 10$, $f = 24$, $C = 47$.

Here 47 is greater than 50. The C.CI is 30 - 40.

$$\text{Median} = 30 + \frac{10}{24}\left(\frac{100}{2} - 47\right)$$

$$= 30 + \frac{10}{24}(50 - 47) \Rightarrow 30 + \frac{10}{24}(3)$$

$$= 30 + \frac{30}{24}$$

$$= 30 + 1.25$$

$$\text{Median} = 31.25 \text{ yrs}$$

(iii). $$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

Here; 28 is the maximum frequency

There the 20-30 is the corresponding mode class interval.

Here $l = 20$, $h = 10$, $f_1 = 28$, $f_0 = 24$, $f_2 = 18$

Substitute the known values we get;

$$\text{Mode} = 20 + \frac{10(28 - 24)}{2 \times 28 - 24 - 18}$$

$$= 20 + \frac{4(10)}{56 - 42}$$

$$= 20 + \frac{40}{14} \Rightarrow 20 + 2.857$$

$$\text{Mode} = 22.857$$

$\therefore$ Mean = 32.4, Median = 31.25,

Mode = 22.857.

2.

C-I	0-20	20-40	40-60	60-80	80-100
f	41	51	64	38	7

Solution:

C.I	f	midx	xf	cf
0-20	41	10	410	41
20-40	51	30	1530	92
40-60	64	50	3200	156
60-80	38	70	2660	194
80-100	7	90	630	201
	N = 201		Σxf = 8430	

(i). Mean $= \frac{\Sigma xf}{N} = \frac{8430}{201} \Rightarrow 41.94$

(ii). Median $= l + \frac{h}{f}\left(\frac{N}{2} - c\right)$

$\frac{N}{2} = \frac{201}{2} \Rightarrow 100.5$

Here 156 is greater than 10.5 there the Corresponding median class interval 40-60

Here $l = 40$, $h = 20$, $f = 64$, $N = 201$, $c = 92$

Substitute the known values we get:

$$\text{Median} = 40 + \frac{20}{64}\left(\frac{201}{2} - 92\right)$$

$$= 40 + \frac{20}{64}(100.5 - 92)$$

$$= 40 + \frac{20}{64}(8.5)$$

$$= 40 + \frac{170}{64} \Rightarrow 40 + 2.656\,25$$

Median = 42.656 25.

(iii). $\text{Mode} = l + \dfrac{h(f_1 - f_1)}{2f_1 - f_0 - f_2}$

Here 64 is the maximum frequency there the corresponding 40-60 is the mode.

Class interval.

Here $l = 40$, $h = 20$, $f_1 = 64$, $f_0 = 51$, $f_2 = 41$

Substitute the known values, we get.

$$\text{Mode} = 40 + \frac{20(64 - 51)}{2 \times 64 - 51 - 41}$$

$$= 40 + \frac{20(13)}{128 - 92}$$

$$= 40 + \frac{260}{36} \Rightarrow 40 + 7.222$$

Mode = 47.222//.

Mean = 41.94, Median = 42.625626,

Mode = 47.222.

8.

Value	:	0-9	10-19	20-29	30-39	40-49	50-59	60-69
f	:	350	720	664	598	524	878	244

Solution:

Value	f	mid x	xf	Cf
0-9	350	4.5	1575	M350
10-19	720	14.5	10440	1070
20-29	664	24.5	16268	1734
30-39	598	34.5	20631	2332
~~39-40~~		44.5	23318	2856
40-49	524			
~~49~~ 50-59	878	54.5	20601	3234
50-69	244	64.5	15738	3478

$N = 3478 \qquad \Sigma xf = 108571$

(i). $\text{Mean} = \frac{\Sigma xf}{N} = \frac{108571}{3478} = 31.216503\dot{7}\dot{4}$

(ii). $\text{Median} = l + \frac{h}{f}\left(\frac{N}{2} - c\right)$

$N = 3478, \quad \frac{N}{2} = 1739$

2332 is greater than 1739. Then the corresponding class interval is 30-39

Here $l = 30, f = 598, c = 1734, h = 4.5$

Substitute the known values we get,

$$\text{Median} = 30 + \frac{4.5}{598}(1739 - 1734)$$

$$= 30 + \frac{4.5 \times 5}{598}$$

$$= 30 + \frac{20.5}{598} \Rightarrow 30 + 0.037$$

Median $= 30.037$ //.

(ii). $$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

Value	Value (True C.I)	f	
0-9	-0.5-9.5	350	
10-19	9.5-19.5	420	f_1
20-29	19.5-29.5	664	f_0
30-39	29.5-39.5	598	f_2
40-49	39.5-49.5	524	
50-59	49.5-59.5	378	
50-69	59.5-69.5	244	

Here 420 is the maximum frequency.

Hence 9.5-19.5 is the mode class interval

$$\text{Mode} = l + \frac{h(f_1 - f_0)}{2f_1 - f_0 - f_2}$$

$$= 60 + \frac{10(720 - 664)}{2(720) - 664 - 598}$$

$$= 10 + \frac{10(56)}{1440 - 1262}$$

$$= 10 + \frac{560}{148} \Rightarrow 10 + 3.146$$

Mode = 13.146 //..

Mean = 31.2165, Median = 30.034, Mode = 13.146.

4. Variance & Standard deviation.

Let $x_1, x_2 \ldots x_n$ be given values, the va

is given by

$$\text{Variance} = \frac{\Sigma (x - \bar{x})^2}{n}$$

$$= \frac{\Sigma x^2}{n} - \bar{x}^2$$

For frequency distribution,

$$\text{variance} = \frac{\Sigma f (x - \bar{x})^2}{N}$$

$$= \frac{\Sigma f x^2}{N} - \left(\frac{\Sigma f x}{N}\right)^2$$

$$\text{variance} = \frac{\Sigma f x^2}{N} - \bar{x}^2$$

Standard deviation = $\sqrt{\text{variance}} = \sigma$

Coefficient of variation (CV)

$$Cv = \frac{\sigma}{\bar{x}} \times 100$$

Example. 1

Find variance, standard deviation and coeff of variation for the following data:

20, 15, 13, 16, 11, 14, 18, 16

Sol:

x	20	15	13	16	11	14	18
x^2	400	225	169	256	121	196	324

$$\bar{x} = \frac{\Sigma x}{n} = \frac{123}{8} = 15.3$$

$$\text{Variance} = \frac{\Sigma x^2}{n} - \bar{x}^2 = \frac{1947}{8} - (15.3)^2$$

$$= 243.3 - 234.1 = 9.2$$

Standard deviation = $\sigma = \sqrt{\text{variance}}$

Coefficient of variation = $\frac{\sigma}{\bar{x}} \times 100$

=

Example: calculate standard deviation.
5, 10, 20, 25, 40, 42, 45, 48, 70, 80

2. Find variance, standard deviation and coefficient variation for the following frequency distribution.

x:	4	8	12	16	20	24
f:	2	7	18	25	9	4

Sol:

x	f	x^2	xf	x^2f
4	2	4	8	8
8	7	49	56	343
12	18	324	216	5832
16	25	625	400	15625
20	9	81	180	1620
24	4	16	96	384
Total	65		956	23816

$$\bar{x} = \frac{\Sigma xf}{N} = \frac{956}{65} = 14.7$$

$$\text{Variance} = \frac{\Sigma x^2 f}{N} - \bar{x}^2$$

$$= \frac{23816}{65} - (14.7)^2$$

$$= 366.4 - 216.09$$

$$\text{Variance} = 150.3$$

$$\text{Standard deviation} = \sqrt{\text{variance}} = \sqrt{150.3} = 12.25$$

$$\text{Coefficient of variation} = \frac{\sigma}{\bar{x}} \times 100 = \frac{12.25}{} \times 10$$

3. Calculate standard deviation.

x	0	1	2	3	4	5
f	1	2	4	3	0	2

Sol:

x	f	fx	x^2	fx^2
0	1	0	0	0
1	2	2	1	2
2	4	8	4	16
3	3	9	9	27
4	0	0	16	0
5	2	10	25	50
Total	12	29		95

$$\text{Standard deviation} = \sqrt{\frac{\Sigma fx^2}{N} - \left(\frac{\Sigma fx}{N}\right)^2}$$

$$= \sqrt{\frac{95}{12} - \left(\frac{29}{12}\right)^2} = \sqrt{2.0763}$$

$$= 1.44$$

4. Calculate standard deviation and C.V

x	6	9	12	15	18
f	7	12	19	10	2

5. Compute variance, standard deviation and CV.

C.I	4-6	6-8	8-10	10-12	12-14
f	10	17	32	21	20

Sol:

C.I	f	mid x	fx	x^2	$x^2 f$
4-6	10	5	50	25	250
6-8	17	7	119	49	833
8-10	32	9	288	81	2592
10-12	21	11	231	121	2541
12-14	20	13	261	169	3380
	100		948		9596

$$\bar{x} = \frac{\Sigma xf}{N} = \frac{948}{100} = 94.8$$

$$S.D = \sqrt{\frac{\Sigma fx^2}{N} - \bar{x}^2} = \sqrt{\frac{9596}{100} - (94.8)^2}$$

$$= 2.47$$

$$C.V = \frac{S.D}{\bar{x}} \times 100 = \frac{2.47}{94.8} \times 100 = 1.05$$

Find variance, standard deviation and C.V

1) 10, 15, 18, 22, 16, 11, 4, 9

2)

x:	6	9	12	15	18	21	23
f:	2	11	16	40	9	4	3

3)

C-I :	0-10	10-20	20-30	30-40	40-50	50-60	60-70
f :	3	7	15	40	20	11	4

4)

C.I :	0-5	5-10	10-15	15-20	20-25	25-30	30-35
f :	5	15	20	32	60	14	1

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Example. From the following price of gold in a week, find the city in which the price was more stable.

Day :	Mon	Tues	Wed	Thurs	Fri	Sat.
City A	498	500	505	504	502	509
City B	500	505	502	498	496	595

Sol:

City A			City B		
x_1	$x_1 - \bar{x}_1$	$(x_1 - \bar{x}_1)^2$	x_2	$x_2 - \bar{x}_2$	$(x_2 - \bar{x}_2)^2$
498	-5	25	500	-1	1
500	-3	9	505	4	16
505	2	4	502	1	1
504	1	1	498	-3	9
502	-1	1	496	-5	25
509	6	36	505	4	16
3018		76	3006		68

City A

$$\bar{x}_1 = \frac{\Sigma x_1}{n_1}$$

$$= \frac{3018}{6}$$

$$= \text{Rs. } 503$$

$$\sigma_A = \sqrt{\frac{\Sigma (x_1 - \bar{x}_1)^2}{n_1}}$$

$$= \sqrt{\frac{76}{6}} = 3.56$$

$$C.V_A = \frac{\sigma_A}{\bar{x}_1} \times 100$$

$$= \frac{3.56}{503} \times 100$$

$$= 0.71$$

City B

$$\bar{x}_2 = \frac{\Sigma x_2}{n_2}$$

$$= \frac{3006}{6} = \text{Rs. } 501$$

$$\sigma_B = \sqrt{\frac{\Sigma (x_2 - \bar{x}_2)^2}{n_2}}$$

$$= \sqrt{\frac{68}{6}} = \text{Rs. } 3.37$$

$$CV_B = \frac{\sigma_B}{\bar{x}_2} \times 100$$

$$= \frac{3.37}{501} \times 100$$

$$= 0.67$$

Since $CV_B < CV_A$, City B is more stable in sold price.

Example. Goals scored by two teams A and B in a series of football matches were observed as follows:

No. of Goals scored	No. of Matches	
	Team A	Team B
0	5	4
1	7	5
2	5	5
3	3	4
4	2	3
5	3	3

which team A or B may be considered as a more consistent team

Sol:

Team A

Goals x	f	fx	fx^2
0	5	0	0
1	7	7	7
2	5	10	20
3	3	9	27
4	2	8	32
5	3	15	75
Total	25	49	161

$$\text{Mean} = \frac{\Sigma fx}{N} = \frac{49}{25} = 1.96$$

$$\text{S.D} = \sqrt{\frac{\Sigma fx^2}{N} - \bar{x}^2}$$

$$= \sqrt{\frac{161}{25} - (1.96)^2}$$

$$\sigma_A = 1.61$$

$$CV_A = \frac{\sigma_A}{\bar{x}_A} \times 100$$

$$= \frac{1.61}{1.96} \times 100$$

$$= 82.14$$

Team B

Goals y	f	fy	fy^2
0	4	0	0
1	5	5	5
2	5	10	20
3	4	12	36
4	3	12	48
5	3	15	75
Total	25	54	184

$$\text{Mean} = \frac{54}{25} = 2.25 = \bar{y}$$

$$\text{S.D} = \sigma_B = \sqrt{\frac{\Sigma fy^2}{N} - \bar{y}^2}$$

$$= \sqrt{\frac{184}{25} - (2.25)^2}$$

$$= 1.61$$

$$CV_B = \frac{\sigma_B}{\bar{y}} \times 100$$

$$= \frac{1.61}{2.25} \times 100$$

$$= 71.56$$

Since $CV_B < CV_A$, B is better team